Notebook Series -- Notebooks by Edison and Other Experimenters
Navy and Wartime Research Experiments
Notebook, N-18-02-21

This notebook was used in February-March 1918 by William A. Hayes and William Deans for notes pertaining to Edison's work for the U.S. Navy during World War I. There are numerous notations by Edison, many of which are pasted into the book. The entries by Hayes at the beginning of the book describe a series of forty test recordings made at Key West, Florida, on a submarine, a sub chaser, and a sea plane. The recordings were intended to test the performance of submarine detection receivers. The entries in the second part of the book are primarily by Deans, although there are a few by Hayes and most are signed in the name of both experimenters. They describe sound detection experiments based on new instructions from Edison, and some include rough drawings by Edison. The inside front flyleaf is inscribed "Records made for Mr. Edison at Key West" and "W. A. Hayes." The book contains approximately 40 unnumbered pages followed by 52 numbered pages, some of which are blank. Several loose pages of drawings and mathematical equations have been inserted into the book.

Records made for
Mr Edison at Key West.

N. G. Hayes

PF 428

Acme Co.,
MFG. STATIONERS,
96 JOHN ST.
AND
19 PLATT ST.
NEW YORK.

Feb 21 1918

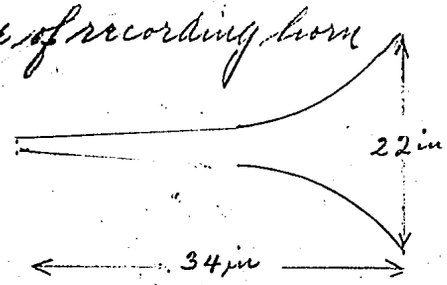
Record #1
Made on Sub-Marine K. 3.
Speed of recording machine 75

Boat running on surface

Engines running full speed (325 turns per minute)

Record made about 10 ft from engines.

Size of recording horn



Feb 21 - 19[illegible]

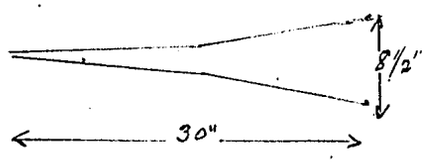
Record #2
made on Sub marine K.3

Speed of recording machine 75

Boat running on surface

Engines running full speed (325 turns per minute)

Record made about 10 feet from engines with smaller bore than one used on #1 record



Feb 21st 1918

Record #3
Made on Sub-marine K. 3
Adjusting Pump alone
Speed of Recording machine 75

Boat running on surface
and submerged.
First half on surface
Second " submerged about
18 feet

Record made with horn 34"
long and bell 22" diameter

Record taken about 6 feet
from pump.

About 450 sec
family strong

Feb 21 1918

Record # 4 Submarine K.3

Steering and diving rudder contacted

Speed of recording machine 75

Speed of boat 6 knots

Horn used 34" long 22" diameter.

Last half of record cut very light

Record made at a distance of about 3 feet.

1500 sec.
Very faint

Feb 21 1918

Record #5 Submarine K. 3
About 6 knots

Main motors and Vacuum pump gearing
Taken about 3 feet from motors and 14 feet from gearing

Speed of recording machine 75

Last part of record cut very light

Horn used 34" long 22" diam.

432

~~750. Vent~~ Vacuum Pump

Feb 21st 1918

Record #6 Sub-Marine K. 3

Main power pumps

First half of record 1 pump running

Second half of record 2 pumps running

Taken about 5 feet from pumps

Speed of recording machine 75

Horn used 34" long 22" diameter

2nd 1/2 2 pumps
More distinct 600 sec

Stronger than Mean
mention recorded
clearer

Feb 21 1918

Record #7 Sub marine K. 3

Engines running full speed on top

Record taken about 30 feet from engines

First part of record cut very light
Second half cut deeper

Speed of recording machine 75

Horn used 34" long 22" diameter

about 1800 to 2000 sec
counting odd vibrations
350 @ 400 sec
some longer vibrations

Feb 21st 1918

Record #8 Sud Machine N. 3

Engineer running while changing
on tape
Record taken about 30 feet from
engine

First part of record cut light

Second part cut lighter

Speed of machine 75

Horn used 34" long 22" diameter

Feb 21st 1918

Record #9 Sub-marine K. 3

Engines running inside, changing 3 different depths of cut

1st deep
2nd fairly deep
3rd lighter

Speed of recording machine 75

Taken about 30 feet from engines

Horn used 34" long 22" diameter

Very big waves!

Feb 25th 1918

Record # 10 K. 3 Sub Marine

Main Motors running with all auxiliaries
out Sub margin about 25 feet
Speed of boat about 7. Knots
Speed of recording machine 75
Taken about 3 feet from motors
with large horn
Recording needle 40/1000
Cut a little too deep

375 per second

Must try again greater distance away
also try with 8/1000 needle

Record #11 Feb 25th 1915

Submarine K.3
Record of Bell used while Trial
is Submerged

Distance away about 30 feet
Taken while submerged 25 feet

Speed of boat about 6 Knots

Speed of machine 70'

Large horn used in recording

40/1000 needle used in recorder.

12
General assortment
of waves &
maximum about
8 waves to one
area of microscope
Strong - less
strong than
Diesel on Sub

2-26-18

Record # 12 Sub. Chaser. # 152
Taken about 12 feet from Engines

Large horn used.
Recording machine speed 75

Speed of Boat 15 Knots

3 Engines running full speed

40/1000 needle used
100 threads to inch

(MR E remarks on opposite page)

General assortment of waves
maximum about 8 waves to 1
area of microscope
Strong but not so strong as
Diesel engines on Submarine

13

Not much
difference in
Volume between
This 12 ft +
30 ft

2-26-18

Record # 13 Sub. Cleaver # 152
Taken about 12 feet from Engines

Large horn used
Recording machine speed 75
Speed of Boat 15 knots
2 Engines running full speed

40/1000 needle used
100 threads to inch

Opposite page 9112 E. Lagos

Not much difference in volume
between this 12 feet away
and 30 feet away

14

Very much
weaker,
think the strength
increases faster
than directly
as the number
of Engines

2-26-18

Record #14 Sub. chart #152

Taken about 12 feet from Engines

Large horn used
Recording machine speed 75
Speed of boat 15 knots
1 Engine running full speed

40/1000 needle used
100 threads to inch

Opposite page 111 Engines
Very much weaker.
Think the strength increased
faster than directly as to
the number of Engines

15

Strength a little more than 1 Engine running about 6 waves to one area of micro—

2-26-18

Record #15 Sub-chaser #152

Taken about 12 feet from Engines

Large horn used
Recording machine speed 75
Boat standing still

Auxiliary engine and compressor running

40/1000 needle used
100 threads to inch

On opposite page Mr E says

Strength a little more than 1 Engine running, about 6 waves to one area of microscope

16

About 2/3
or strength of
15 –
About 4 1/2 @
5 waves
in area

2-26-18

Record #16 Sub-chaser #152

Taken about 12 feet away from engine

Large horn used
Recording machine speed 75
Boat standing still
Auxiliary engine (compressor) alone, running without compressor alone

40/1000 needle used
100 threads to inch

Mrs E. says on opposite page

About 2/3 or strength of #15

About 4 1/2 to 5 waves in area of microscope

17

Not quite so
strong as full
speed,
Seems to have
about same waves
in area which
is strange —

2-26-18

Record #17 Sub. chart #

Record taken about 12 feet from engine

Larger hole used
Recording machine speed 75
Boat running about 8 knots
3 Engines running 1/2 speed

40/1000 needle used
100 threads to inch

Mr E. says on opposite page

Not quite so strong as full speed

Seems to have about same waves in area, which is strange

18

About same strength as full speed & as many if not more knots per area than full speed

2-26-18

Record # 18 Sub-chart # 152

Record taken about 12 feet from the engines

Large horn used
Speed of recording machine 75
Speed of boat about 8 knots
2 Engines running half speed

40/1000 needle used
100 threads to inch

MR Eidsvoll on opposite page

About same strength as full speed and as many if not more knots per area than full speed.

19 –

Seems stronger than when full speed & more waves per area –

2-26-18

Record #19 Sub-chaser #152

Record taken about 12 feet from engines

Large horn used
Speed of recording machine 75
1 Engine running 1/2 speed

40/1000 needle used
100 threads to inch

Mr E. says on opposite page

Seems stronger than when full and more waves per area

20 —

Seems to be about 3/4 of strength of same test at 12 ft

2-26-18

Record #20 Sub. Chart #152

Record made about 27 feet from engines

Large horn used
Speed of recording machine 75
Speed of boat about 15 knots

3 Engines running full speed

40/1000 needle used
100 threads to the inch

MR E. says on opposite page

Seemed to be about 3/4 of strength of same test at 12 feet

21

Considerable
weaker than
at 12 ft

2-26-18

Record #21 Sub-chaser #152

Record made about 27 feet from engines

Large horn used
Speed of recording machine 75

2 Engines running full speed

40/1000 needle used
100 threads to the inch

MW E. says on opposite page
Considerable weaker than
at 12 feet

22

A little weaker than at 12 ft

2-26-18

Record # 22 Sub-class # 152

Record made, about 27 feet from engine

Large horn used
Speed of recording machine 75

1 engine running full speed

11/1000 needle used
100 threads to inch

Mr E says on opposite page

A little weaker than at 12 feet

23

3/4 strength
of full speed

2-26-18

Record #23 Sub-chaser #152

Record made about 27 feet from engines

Large horn used
Speed of recording machine 75
Speed of boat about 7½ to 8
knots

3 Engines running half speed

40/1000 needle used
100 threads to the inch

Mr E. says on opposite page
3/4 strength of full speed

2-26-18

Record #24 Sub-chaser #152

Record made about 27 feet from engines

Large horn used
Speed of recording machine 75

2 Engines running half speed

40/1000 needle used
100 threads to the inch

2-26-18

Record #25 Sub-chaser #152

Record made about 27 feet from engine

Large bass wood
Speed of recording machine 75

1 Engine running half speed

20/1000 needle wood
100 threads to the inch

2-26-18

Record 26 Sub chaser #152

Record made about 27 feet from engines

Large horn used
Speed of recording machine 75

Auxiliary engine running alone
Boat standing still

40/1000 needle used
110 threads to the inch

2-26-18

Record #27 Sub chaser #152

Record taken about 27 feet from engine

Large horn used
Speed of recording machine 75

Auxiliary engine and compressor running

Boat standing still

40/1000 needle used
100 threads to the inch

28

Scarcely can see it

2-26-18

Record 28 Sub-chaser #152

Record made in Bow of Boat about 35 feet from Engines and behind Pilot room

Speed of Recording machine 75'

3 Engines running full speed

Boat speed about 15 Knots

40/1000 needle used
100 threads to the inch

MW E. Taylor opposite page
Scarcely can see it

2-26-18

Record #29 Sub 6 hour #152

Record made in Bow of boat about 35 feet from engines and back of Pilot room

Speed of recording machine 75

3 Engines running full speed

Speed of boat about 15 Knots

8/1000 needle used
200 threads to inch.

DEPARTMENT OF COMMERCE

30

Main Vibration
1 to 8 tenths area
Many Vibrations
Something like
Submarine running
full speed on
Diesel
about 18 Vibs
per area
all together

No. 203
Ed. 6-22-15—1,000,000

2-27-18

Record # 30 Sea Plane # 435

Record taken in open air about
40 feet from machine

Large horsepower
Speed of revolving machine 75
40/1000 needle movement
100 threads to the inch

Plane standing still engines
running full speed

Mr E. says on opposite page.

Main vibrations 1. to 8 tenths area
many vibrations something like
submarine running full speed
on Diesel; about 18 vibrations
altogether.

DEPARTMENT OF COMMERCE

31

Very much
weaker
3 times or more
weaker

No. 203
Ed. 6-22-15—1,000,000

2-27-18

Record #31 Sea Plane #435

Record taken about 40 feet from
machine

Large horn used
Speed of recording machine 75
40/1000 needle used
100 threads to the inch

Plane standing still
Engines running half speed.

MR E. snap on opposite page

Very much weaker
3 times or more weaker.

DEPARTMENT OF COMMERCE

32

Where wind gusted. Very strong waves 25

all together in area – big & little at start

Dies away very rapid. Get nothing

No. 203
Ed. 6-22-15—1,000,000

2-27-18

Record # 32 Sea plane. #435

Start of record made about 40 feet from machine

Large horn used
Speed of recording machine 75
40/1000 needle used
100 threads to the inch

Plane starting and going out gradually.

" "

MR E says on opposite page

Where wind gusted very strong waves 25 all together in area big and little at start

Dies away very rapidly get nothing.

DEPARTMENT OF COMMERCE

33

Just see it when
150 ft overhead

ditto another

Extremely faint

No. 203
Ed. 6-22-15—1,000,000

(33)

Mr E. says above
Just see it when 150 feet
overhead

Ditto another

Extremely faint

2-27-18

Record # 33 Sea Plane # 435

1st Part of record.
Plane coming in and stopping
about 40 feet away
When I started to record I should
judge the Plane to be 150 feet
away.

Wind was blowing in my favor.

2nd part
Plane passing over head about
150 feet in air
Packed very rapidly

3rd part
Plane landing and coming
to stop.
Plane about 45 feet away
when stopped
Plane about 100 to 125 feet
away when I first started to
record and on the water.

3-4-18

Record# 34 Sea Plane 34

Start of record made about 40 feet from Plane and I continued to follow Plane trying to record until it had reached a distance of about 900 feet.

Large horn used
Speed of recording machine
75 R.P.M.
40/1000 needle used
100 threads to the inch

Plane starting and going away

3-4-18

Record #35 See Plane 3rd.

Start of record made about 65 ft from Plane and I continued to follow Plane trying to get record until Plane drove from the water, about 300 feet away

Large horn used
Speed of recording machine 75
49/1000 needle used
100 threads to the inch

Plane starting and going away.

36 —

~~Does not~~

It's faint but quite distinct
Could hear this
I think at 1,000
yards if noise
only little,

3-6-18

Record # 36 Submarine K. 3

Motor operating diving rudder

Record taken about 12 feet from motor

1st trial cut very light

2nd trial cut deep.

These noises occur intermittently operated by wheel.

Large horn used

Speed of recording machine 75

6/1000 needle used

100 threads to inch

Motor 1 Horse Power 450 R.P.M.

37

Very much
2 Conger –

3-6-18

Record # 37 Submarine K. 3

Motor operating diving rudder
Record taken about 8 feet from the motor
1st trial cut light
2nd " " lighter still
3rd " " deeper

These noises occur intermittently operated by wheel

Large horn used
Speed of recording machine 75
40/1000 needle used
100 threads to the inch

Motor 1 horse power 450 R.P.M.

38-

Quite strong
stronger than
37 - don't
think be any
trouble 1000
yards on this

3-6-18

Record #38 Sub marine K.3

Motor operating steering rudder
2 H.P. 450 R.P.M.

Record taken about 12 feet from
motor

1st trial cut light
2nd " " deeper

These noises also occur intermittently
operated by wheel

Large line used
Speed of recording machine 75
40/1000 needle used
100 threads to the inch

39 -
faint but
good -

3-6-18

Record # 39 Sub-marine K. 3

This record has both the Diving and Steering motor noises on it
Taken in Forward Battery department
about 25 feet away.
1st Part Diving motor (25 ft away)
1st trial cut deep
2nd " " lighter
— " — " — 1 H.P. 450 R.P.M.

2 Part Steering Motor (25 ft. away)

1st trial cut lighter
2nd " " little deeper
3rd " " still deeper.

Noises occurs underneath (?)

Large horn used
Speed of machine 75
40/1000 needle used
120 threads to inch
2 H.P. 450 R.P.M.

40

Stronger than Diving Rudder Wheel should hear this sound at 1000 yds when down

3-6-18

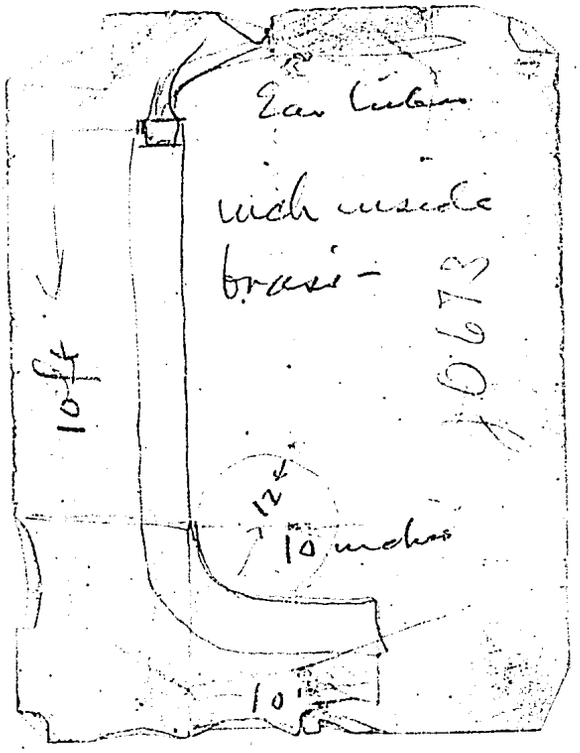
Record # 40 Submarine K. 3

Motor Generator for Periscope Engine
Speed 2250
Also Voltage regulator for above
Record taken about 1½ feet away

Second part of each trial is the voltage regulator which is the carrier wave the louder

3 cuts Tandem
1st deep
2nd lighter
3rd deeper than 2nd cut

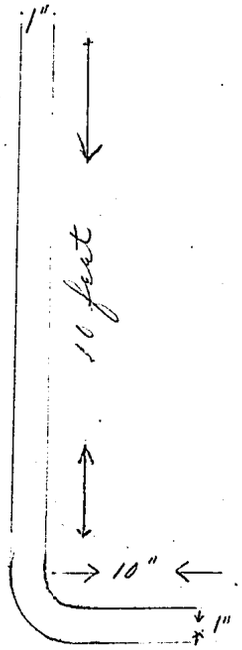
Large hook used
Speed of recording machine 20"
40/1000 needle used
100 threads to the inch



March 7th 1918

①

At Mr E. instructions had a brass tube fellanning dimensions made



Bend to radius 12"

March 8th 1918

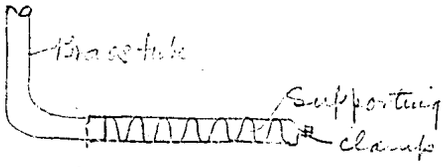
Tried tube submerged in water 4 parts in water and 1 part with air.
Heard boats passing about 300 feet away but sound was very weak and somewhat metalic

Tried tube at different depths and found that when I pulled nearer the surface sound became weaker

March 9th

Went out to long dock near forts and tested with "Moores bell" which I could only get about 150 feet away. I then put a rubber diaphragm over mouth of tube submerged and found sound much better in fact could get bell about 250 feet easily I also could get boats of all sizes 250 yards or 750 to 800 feet away.

Had devices made up to attach to lower end of tube as follows. Each consisted of a rubber tubing supported on a brass spring, and closed at the outer end.



These Rubber ends were of following dimensions

#1	12" long	–	circular cross-section
#2	9" "	–	" "
#3	6" "	–	" "
#4	3" "	–	" "
#5	6" "	–	Elliptical "
#6	12" "	–	square "

Results, March 14th.

With 12" circular can hear Moore's Bell at distance of about 425 feet.

Same for 9" circular

for 6" circular from 400 to 425 feet.

with 3" circular — same (400 to 425 feet)

The results with the elliptical and square cross-section tubes were the same as with the circular tube.
Varying the shape of the tube seems to make no difference.

The sound heard seems louder when the end of the tube is pointing toward the source.

In order for this scheme to work the all water must be kept out of the tube. As soon as water enters the tube, its usefulness is destroyed — the device ceases to be used.

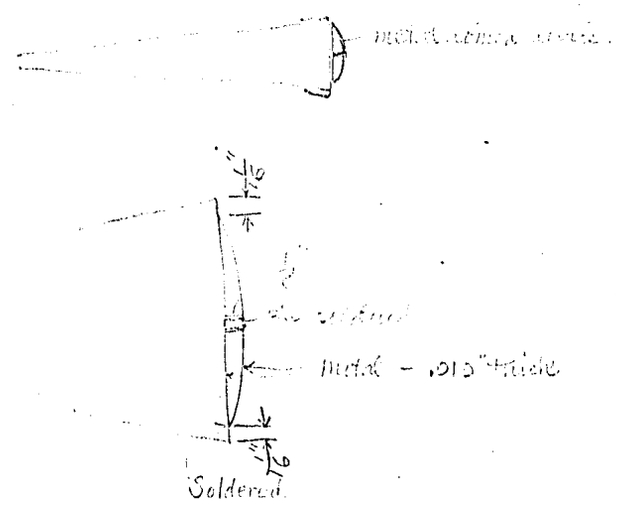
Must get some new device for supporting rubber tubes. Schemes —
(1) Drill tube full of holes
(2) Support rubber on rods run longitudinally.

Party
Hayes & Crane

Apr. 15, 1915.

Experiments carried on by [illegible] as follows.

Attach horn — 2½" opening about 7 ft 6" long to end of listening tube
1st — [illegible] horn — get listener.
2nd — try device shown for distance



Tests for distance of hearing bell in air taking into account direction of the wind.

Early — Hayes & Stone.

March 16th

Tried horn fitted with rubber diaphragm over mouth, as under "1st" on preceding page.

Results - greatest distance at which Moore's bell could be heard = 425 feet.

Then tried same outfit except that on diaphragm we had mounted the metal domed device as under "2nd." on preceding page.

Results for distance same as before (425 feet).

With this device, the tone heard was more metallic than with the plain diaphragm. The real sound of the bell could be heard with greater sharpness than when this additional device was not used.

Just as we had completed the tests and Mr. Hayes was listening to a boat in the channel the diaphragm broke.

Tests in air for effect of wind.

Method of tests Pointing the horn with the mouth toward the bell, we gradually moved the bell away from the horn until the sound from the bell could no longer be heard. The directions in which the bell was moved were as follows.

1 - into the wind, that is so that the wind blew from the source of sound to the horn
2 - in the direction of the wind, — so that the sound travelled from source to sound against the wind.
3 - at right angles to direction of wind to left of observer.
4 - at right angles to direction of wind to right of observer.

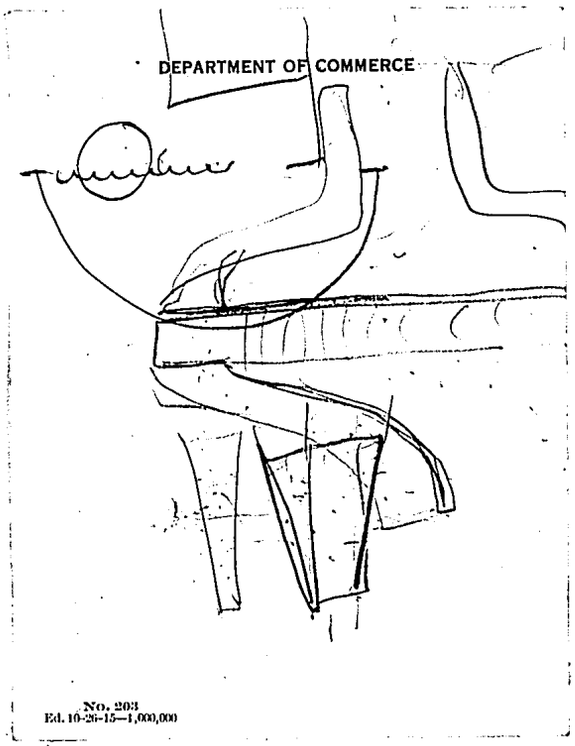
Results

For 1 (sound travelling with the wind) the sound of the bell was lost at a distance of 85 feet.
2 (sound against the wind) sound lost at distance of 75 feet.
3 and 4 Results the same — distance 80 feet.

Additional tests.

We listened to the bell, to the exhaust of the engines in the Electric Power House on the main land, and to the noise of an aeroplane. We pointed the mouth of the horn (1) toward the source (2) at right angles to the line between source and horn (3) directly away from source.

Results. There seemed to be very little diffe[illegible] in the intensity of the sounds heard for these three positions of the horn. With the horn pointing



toward the source, the sound was most intense but, to repeat, there is very little difference in the intensity of the sound heard for a revolution of the horn through a complete circle.

Party Hayes & Brown.

Mar. 17, 1918

Experiments given by Mr. E.

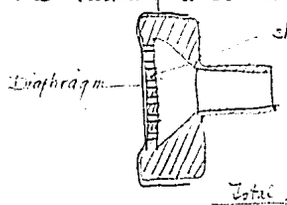
1 – Try large diaphragm – don't go too deep.

2 – Try diaphragm on tube alone and then feel how one same as in air recording.

Large diaphragm Peak 450 feet submerged 2 feet 6 inches

Also.

3 Try rubber diaphragm mounted on backing. The backing to consist of a perforated sheet of metal.



187 holes $\frac{1}{16}$" diameter

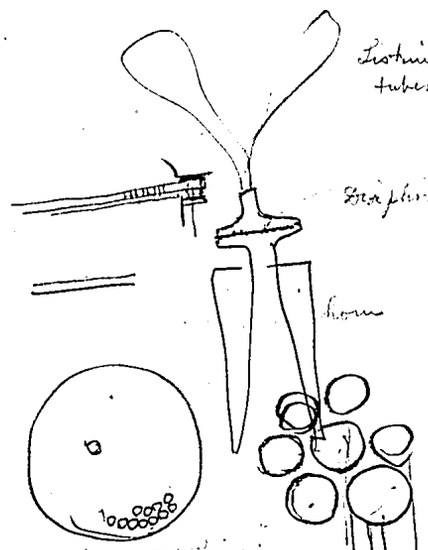
Plate $\frac{1}{16}$" diameter

$\frac{\text{Total area small holes}}{\text{area } \frac{1}{16}\text{" plate}} = 51.8\%$

Results: –

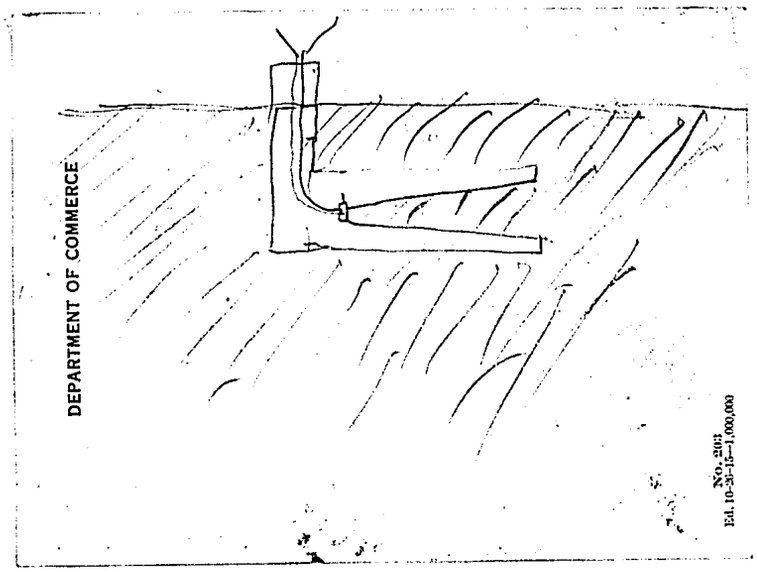
Distance Morse bell could be heard 550 feet.

Putting diaphragm deeper into the water seems to increase the sensitiveness of the instrument. Thus at 550 feet with diaphragm 18" under surface the bell was just heard, submerging to about 4 feet the bell could



be heard at this distance very distinctly.

4- Try horn with short pipe and put listening tubes close to the mouth of pipe.



5 (A). Surround the horn and all of the connecting tube under water with an air chamber.

Distance [illegible] 750 feet.

[illegible]

Horn [illegible] 2.3 inches long.

1" small dia. [illegible]

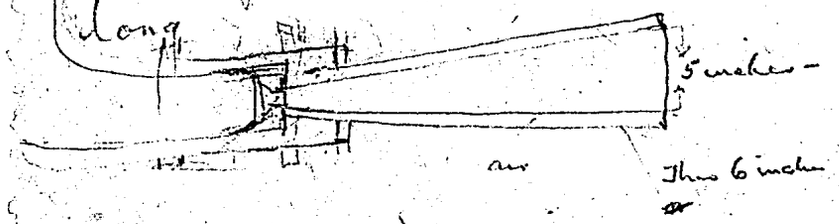
wooden frame [illegible] 9/1000

5 (B) Pump out air in [illegible] tube having a [illegible] and inside pipe. Vacuum 20 inches

[illegible] air in space between the outside casing and the [illegible] pipe.

Hayes –

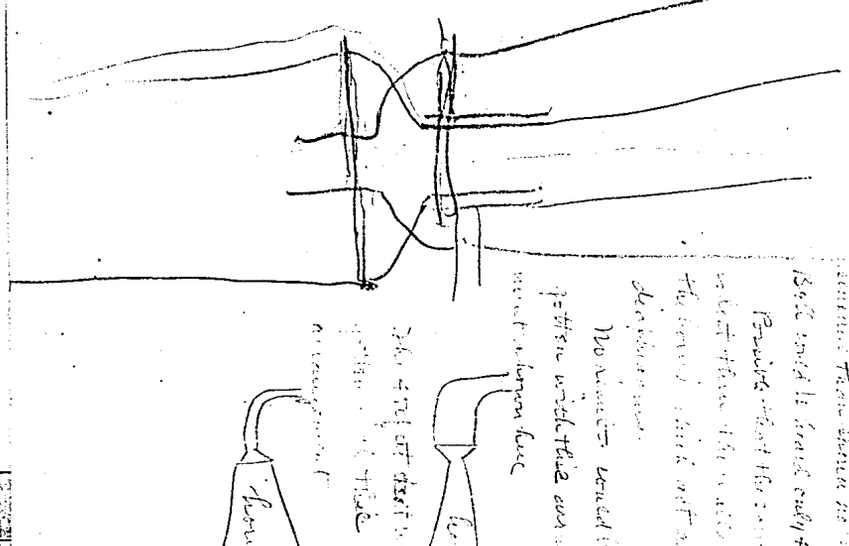
Double funnel should be 60 inches long

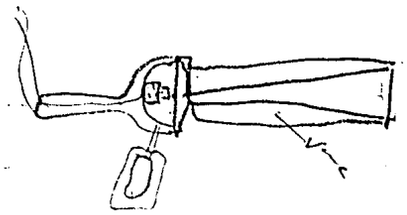


Bolder tip to funnel

This should give you 1250 ft.

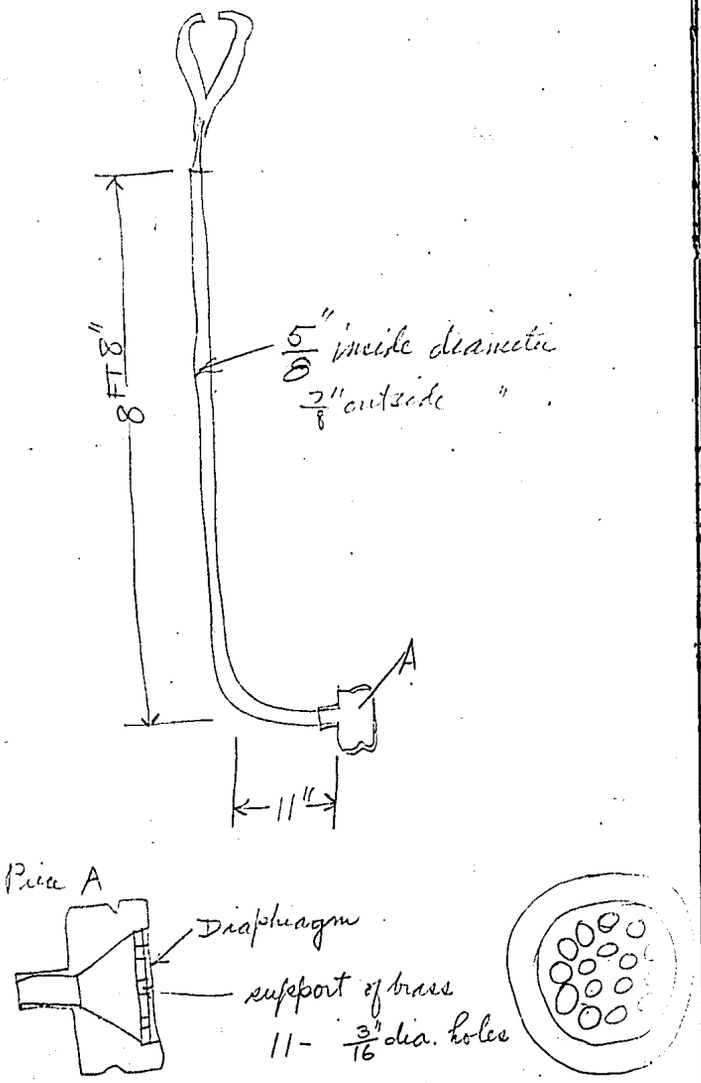
make whole thing more Experiment way





DEPARTMENT OF COMMERCE
NO. 203
ED. 10-20-16—1,000,000

I. [illegible] on page 18 consisting of a transmitter equipped with a [illegible] tect for electrons in the funnels of different shapes to find the best profile for the funnel.



Monday

Tried out rubber diaphragm in double walled apparatus described on page 15. Air not pumped out.

Results Could hear Morse Bell at a distance of 450 feet.

Diaphragm about 3 feet below surface.

Also tried out apparatus shown on opposite page.

Diaphragm used — a stretched piece of Dentists' dam rubber. An apparatus made of thicker, heavier material seems to give better results than one made of lighter material, such as galvanized iron or tin. That made from heavier material is quieter and therefore seems better than one of lighter material.

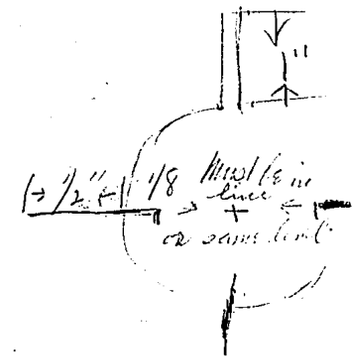
Distance bell could be heard = 650 feet.

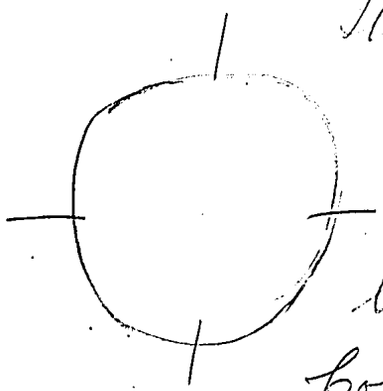
No horn used. Diaphragm submerged 3 feet.

Air cavity - backing disk — 16 holes 1/4" dia $\frac{\text{hole area}}{\text{disk area}}$ = 71%

It seems to us that an uninsulated apparatus built from heavy material, thatter, with walls of greater thickness, will give better results.

Party Hayes + Crane





Nick 3/32

Contacts built in copper of pressure

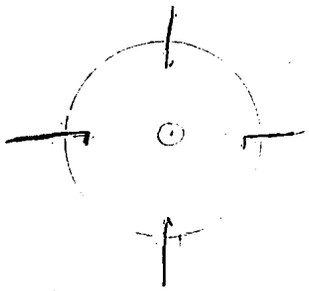
Shape of contacts all 4 in order perfect down bottom contact straight

Et

A. Gerkoda
U.S.S. K. 3
c/o Post-master
New York.

for Packages.

P. D. Payne.



$$(m^2+1)\,x^2 - 2Ax + A^2 - R^2 = 0$$

$$x = \frac{2A \pm \sqrt{4A^2 - 4(m^2+1)(A^2-R^2)}}{2(m^2+1)}$$

$$x = \frac{A \pm \sqrt{A^2 - (m^2+1)(A^2-R^2)}}{m^2+1}$$

Solve for y;

$$x = \frac{1}{m}y$$

Subst in Eqn. (2)

$$\left(\frac{y}{m} - \text{wt.}\right)^2 + y^2 = v^2 t^2$$

$$\left(\frac{y}{m} - A\right)^2 + y^2 - R^2 = 0$$

$$\frac{y^2}{m} - \frac{2Ay}{m} + A^2 + y^2 - R^2 = 0$$

$$\left(\frac{1}{m} + 1\right) y^2 - \frac{2Ay}{m} + A^2 - R^2 = 0$$

$$\cancel{(m+1)\,y^2 - 2Ay + mA^2 - mR^2 = 0}$$

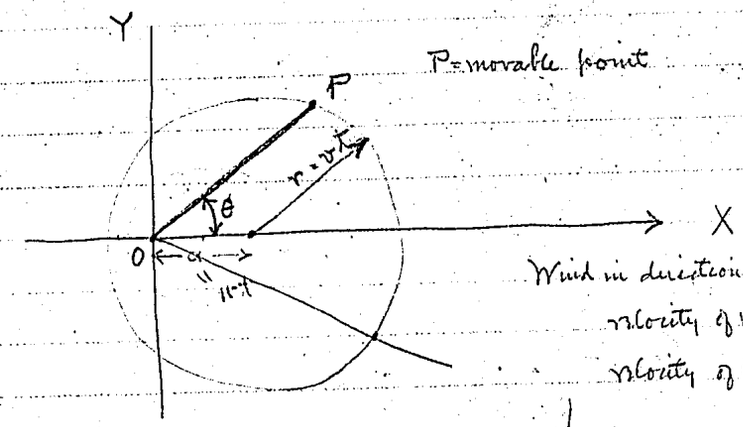
$$\cancel{y = \frac{A \pm \sqrt{A^2 - m(m+1)(A^2-R^2)}}{m+1}}$$

$y = mx.$

$$(m^2+1)\,y^2 - 2mAy + m^2(A^2-R^2) = 0$$

$$y = \frac{mA \pm \sqrt{m^2A^2 - (m^2+1)\,m^2(A^2-R^2)}}{(m^2+1)}$$

$$= \frac{m\left\{A \pm \sqrt{A^2 - (m^2+1)(A^2-R^2)}\right\}}{(m^2+1)}$$



P = movable point

Wind in direction of X.

velocity of wind = w feet per sec.

velocity of Sound = v feet per sec.

(1) $(x-\alpha)^2 + y^2 = r^2$

$\alpha = wt$

$r = vt$

(2) $(x - wt)^2 + y^2 = v^2t^2$

Circle P – equipotential line for Sound intensity

(3) Equ. line OP $y = mx$ $m = \tan\theta$

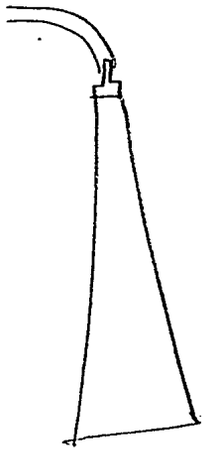
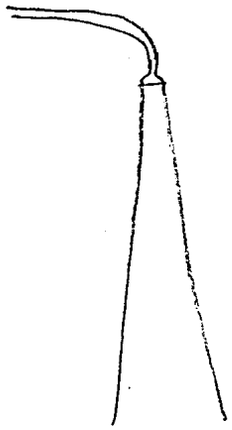
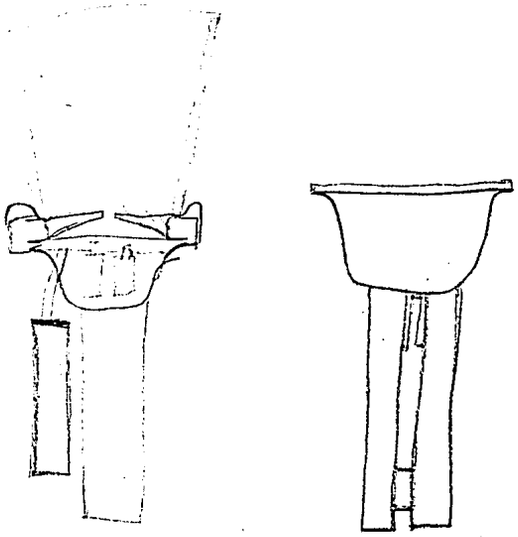
Substitute (3) in 2

$(x - wt)^2 + m^2x^2 = v^2t^2$

Now consider particular equipotential line where wt and v^2t^2 become constants. say A + R. [R = radius]

$(x - A)^2 + m^2x^2 = R^2$

$x^2 - 2Ax + A^2 + m^2x^2 - R^2 = 0$

$A = wt$ Wind

$R = vt$. Sound.